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EXPLORATORY DEVELOPMENT RESEARCH EFFECTIVENESS: A
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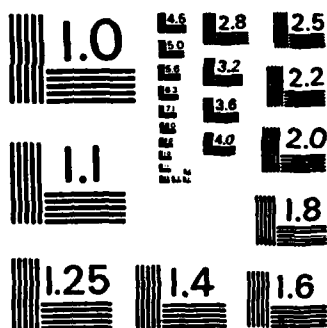
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**EXPLORATORY DEVELOPMENT RESEARCH EFFECTIVENESS
A SECOND EVALUATION**

by

Thomas A. Buckles

James A. Jolly

J. W. Creighton

September 1978

Prepared for: NAVAL FACILITIES ENGINEERING COMMAND, ALEXANDRIA, VIRGINIA

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ABSTRACT

A second study was conducted to evaluate the transition (utilization) of the output of one category of exploratory development research sponsored by the NAVFACENGCOM. A detailed investigation was made concerning the transition of thirty work units (projects) that had been the subject of a study conducted previously (Jolly, Creighton, Buckles, 1977).¹ The second evaluation occurred at NAVFACENGCOM Headquarters, Alexandria, Virginia and involved each of the program managers located there.

The data from this study showed that the output of 43.33% of the work units had transitioned. The factor exerting the most influence on the transition of a work unit's (project's) output again was the amount of technology transfer effort given to it. It was shown statistically that the likelihood of project transition was directly related to the degree of effort directed to technical reports, technical memoranda, technical data sheets and other forms of technical information dissemination, and technical specialization. In contrast, it was also again found that the likelihood of transition of a work unit (project) was not significantly influenced by the years since the work unit was completed, nor by work unit cost.

Cross-tabulations of these data are included in the report. The work units studied, as well as pertinent related data, are listed in the appendix.

¹Jolly, J.A., J. W. Creighton, and Thomas Buckles, "Exploratory Development Research Effectiveness," California State University, Sacramento, School of Business and Public Administration - CSUS-NPS J077091

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Objective

The objective of this study is to further evaluate the investigation of the effectiveness of the NAVFACENGCOM exploratory development program at the Navy's CEL. This is done by a second examination of the previous study's sample of completed work units, in order to determine the number that have either resulted in a product or service, or have been used as the base for further research. (This process will be referred to as "transition" in this report.)

Discussion

In order to develop a more complete profile of the effectiveness of the exploratory development program being executed at the Navy's CEL, it was decided to replicate the research procedure at NAVFAC Headquarters. This time, however, the program managers would be the respondents. In the first study, the laboratory project managers were the respondents.

Since there are five program areas, and each manager is responsible for a particular program area, the number of respondents was quite a bit lower than it was in the original research effort. The program areas and their respective managers are shown in Figure 1. Due to the few contacts that needed to be made, as well as the fact that part of the responsibility of the program managers is to know the status of the different projects in their own programs, obtaining the requisite data was not difficult. In general, each program manager was able to provide the needed information on the spot, except for several instances in which someone else was called upon to verify a point or two.

In addition, because the subject of this investigation is the same as last year's Navy CEL study, there was no need to select a sample population of work units. A complete list of the projects investigated is included in the appendix.

<u>PROGRAM AREA</u>	<u>PROGRAM MANAGERS</u>
Advanced Base and Amphibious Facilities	Mr. Mel R. Herrmann
Ocean Engineering	Mr. Pat H. Cave
Shore and Harbor Facilities	Mr. Herb Lamb
Environmental Protection	Mr. Steve M. Hurley
Energy Systems	Mr. Walt Adams

Figure 1.

Program Areas and their respective Managers

Methodology

Due to the availability of the data that had been gathered in the previous year, it was not necessary to replicate the data gathering procedures. The work units were grouped into program areas in order to determine which program manager should be interviewed concerning a particular work unit. Each interview was personal and completely open-ended, and lasted for approximately 45 minutes.

A breakdown of the five areas and the appropriate work units is provided in the appendix.

Results

The degree of transition of the work units was divided into three categories: "yes", "potential", and "no". The "potential" category was defined as the condition in which the project results were not currently in use, but there was strong belief by the person interviewed that the project results would be used in the future. Figure 2 presents the results obtained from the interviews. The percent transitioned was 43.33%. A complete list of the projects investigated is included in the appendix. Title, accounting number, technical information numbers, and approximate project cost are shown.

It was determined that several factors could influence the rate of transition. One factor that is of particular interest may be defined as the technology transfer effort. The hypothesis was that the more technology transfer effort expended, the more likely it would be that a project would transition. The degree of technology transfer effort was divided into three levels: "low", "medium", and "high". A low technology transfer effort took place when only one report was written. If two reports were written, the work was classified as having medium technology transfer effort.

	TRANSITIONED CATEGORY			
	YES	POTENTIAL	NO	TOTAL
Number of Projects (work units)	13	5	12	30
	43.33%	16.66%	40%	

Figure 2.

Number of projects in each of the transitioned categories. The table shown in Figure 2 gives the results of the study in terms of the transitioned characteristics of each of the work units as reported by the scientist or engineer most familiar with the utilization.

Any work unit that had two or more written reports, plus additional promotional effort, such as a video display, journal article, or similar effort, was classified as having a high technology transfer effort. Figure 3 shows the tabulation of the work units classified according to technology transfer effort.

While the individual cell totals and column and row totals differ from the previous report (Jolly et al, 1977), statistical testing showed that the technology transfer effort appeared to influence the probability that a work unit would be successfully transitioned. The Chi-Square test indicated a better than 99% confidence that there was difference between the distribution of the transitioned categories when grouped according to the degree of

technology transfer effort.

		YES	POTENTIAL	NO	TOTAL
Relative Technology Transfer Effort	HIGH	4	1	2	7
	MEDIUM	2	3	3	8
	LOW	7	1	7	15
	TOTAL	13	5	12	30

Figure 3.

Transitioned category vs relative technology transfer effort. The table shown in Figure 3 reports the results of the investigation directed at determining the importance of technology transfer effort in terms of causing a work unit to transition.

Another factor which showed statistical significance in the previous study was the relationship of technology specialization and its possible implication in terms of causing a work unit to transition. This is because, it seemed, technological interest and/or technological emphasis could vary depending upon the mission needs of the NAVFACENGCOM. Figure 4 presents the data after the second study. Again, the Environmental Protection and Energy Systems work units are included as part of the Shore Harbor Facilities.

In the new configuration, no category holds a more favorable position than any other, but it is apparent that the distribution of transitional categories is different for each technology specialization. Compared statistically (Chi-Square), the differences in the distribution of the transitioned categories were indicated to be very significant. (The confidence level was 99% that the distribution of the transitioned categories was different.)

		TRANSITIONED CATEGORY			
		YES	POTENTIAL	NO	TOTAL
Technology Specialization of Work Units	Shore and Harbor Facil.	5	0	5	10
	Ocean Engineering	5	2	3	10
	Adv. Base Amph. Facil.	3	3	4	10
	Total	13	5	12	30

Figure 4

Transitioned Category vs Technology Specialization of the Work Units.

The above cross-tabulation shows the relationship between the area of technology specialization of the work units and the determination of the transitioned category.

		TRANSITIONED CATEGORY			
Year	Years Ago	YES	POTENTIAL	NO	TOTAL
(FY1972)	5	3	2	2	7
(FY1973)	4	2	0	5	7
(FY1974)	3	2	1	2	5
(FY1975)	2	3	1	1	5
(FY1976)	1	3	1	2	6
Total		13	5	12	30

Figure 5

Transitioned Category vs Years in which the transition occurred.

The cross-tabulation shown in Figure 5, is an investigation of the longitudinal effect upon transitioned categories. The data does not support the belief that older projects have a higher probability of enjoying transition.

Another hypothesis was that the transition rate of the work units should be best for earlier years (i.e., FY 72 or FY 73) because there has been a longer time period for transition to occur. This was also studied a second time, and as in the previous report, this hypothesis does not seem to hold true. The data presented in Figure 5 shows the distribution of the transitioned categories. Using the Chi-Square statistic, there was no significant evidence that the year-to-year distribution was different from that expected by simple random variation.

Work Unit Cost	TRANSITIONED CATEGORY			
	YES	POTENTIAL	NO	TOTAL
\$0 to \$49,999	5	1	5	11
\$50,000 to \$99,999	3	1	5	5
\$100,000 and Above	5	3	2	10
Total	13	5	12	30

Figure 6

Transitioned work Units by Category vs Work Unit Cost in Dollars.

In the three-by-three cross-tabulation shown above, the objective was to investigate a relationship between Transitioned Category and Work Unit Cost. The Work Unit Cost was divided into classes. The data did not support the contention that Work Unit Cost influenced the degree of transition.

The last postulate that was tested concerned work unit classification by dollar amount. It was hypothesized that higher dollar effort work units would receive more scientific and administrative attention and, thus would be favored for the likelihood of transition. When the Chi-Square test was applied, the data was not able to support this idea. Figure 6 presents the data.

Conclusion

A second evaluation of a longitudinal study of the work units (projects) completed during a five-year period at the Navy's CEL (FY 72 to FY 76, inclusive) was completed. The current investigation consisted of interviewing the five program managers at NAVFACENGCOM Headquarters. When the data were collected and analyzed, they indicated that a 43.33% transition had been accomplished for the work units. Though slightly lower than that of the first study, the degree is still quite considerable.

There is some danger, however, in projecting these new findings to the total population of work units completed at the Navy's CEL. While the bias of personal opinions by the engineers and/or scientists who were assigned to the various work units has been virtually eliminated, the two points still need to be mentioned:

1. The study spans a five-year period; and
2. The stratified random sample was relatively small (thirty units total).

If one is willing to accept these warnings of conservatism, then it seems reasonable to look beyond the initial findings. The findings in this study substantiate the previous report's findings; namely:

1. There is a direct relationship between the degree of technology effort, as applied to a completed work unit, and the likelihood that the output of that work unit will be utilized.
2. The technology specialization of the work unit appeared to influence the likelihood that a completed work unit would be transitioned.

3. Time did not seem to be important. That is, projects or work units completed several years ago were not more likely to have enjoyed transition than the most recently completed work units. Further, the length of time that it took to complete a work unit did not appear to influence the likelihood of transition. However, recent technology transfer effort may influence the likelihood of transition.

This second evaluation study reinforced the contention that technology transfer is more the result of a positive overt effort than that of a unique or outstanding technological discovery. As long as the technological discovery is recognized by qualified scientists and engineers as offering something useful and desirable, the rate of utilization of that technology can be effectively enhanced by increasing the technology transfer effort.

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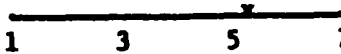


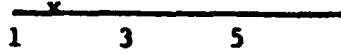
Robbins, Marty D., et. al., Mission-Oriented R & D and the Advancement of Technology: The Impact of NASA Contributions, prepared for NASA under contract NSR 06-004-063 by Industrial Economics Division, University of Denver Research Institute, Denver, Colorado, May 1972, pp 354.

Wilson, Duncan M., Utilization of Research Results in the Building Industry, Boston Architectural Center, Boston, Mass., June 1974, pp 162.

WORK UNIT DESCRIPTION

TRANSITIONED WORK UNITS (13 total)

The "x" on the scale that is marked from one to seven, which accompanies each work unit description, is used to display the technology transfer effort associated with that work unit. The one on the left of the scale indicates low technology transfer effort while the seven on the right indicates high technology transfer effort.

- 1) Stress Analysis of Navy VLF (very low radio frequency) Antenna Insulators. TR 839. (YF 53.534.011.01.001 F)
\$56,747
Used to improve the design of insulators for Navy ULF antennas at Annapolis, Lualualei, and other locations. 
- 2) Underwater Repair of Electromechanical Cables in situ as Opposed to Resurfacing Before Effecting Repairs. TN 1437; TDS 75-29; (YF 52.556.003.01.009)
\$7,805
Used in SEACON II project. Also DOD interest. 
- 3) Evaluation of Shrinkable Splice Covers for Underground Distribution Cables (600-volt). TN 1325* TR 835; TDS 74-03. (YF 54.543.008.01.005)
\$19,167
Used by Navy and Bureau of Mines. 
- 4) An Investigation for an Improved Water Emulsion Marking Paint for Military Asphaltic Runways. (YF 51.543.006.01.014)
\$7,931
Resulted in a GSA specification. Used by tri-service and some Federal agencies. 
- 5) To Develop a Method to Produce an Antifouling Marine Concrete. TN 1392; TN 1402. (YF 54.593.007.01.001)
\$335,134
Widely publicized by presenting technical papers and Journal articles. Large range of use within Navy and by others. 
- 6) Deep Ocean Test-In-Place and Observation System for Naval Sea Floor Construction Support. TR 152. (YF 38.535.002.01.012)
\$491,975
Used as a support system for many Navy projects (sediment testing, mooring, etc.). 

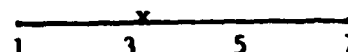
- 7) Develop Satisfactory, Non-leaking Seals and Gaskets for Closing Openings and Penetrations in Navy Seafloor Structures. YF 38.535.005.01.008)
\$216,591
Used by Navy contractors on sea floor project. 1 x 3 5 7
- 8) Testing of High Flotation Tires to Determine Suitability for Use in Cargo Transporting Vehicles in Snow-covered Polar Regions. TN 1405. (YF 52.555.002.01.002)
\$335,792
Used by Navy and Air Force. Also used by private sector in Northern California for tractors and sand vehicles. 1 x 3 5 7
- 9) To Develop the Capability and Equipment to Unload a Containership in an Open Sea Environment. TN 1313. (YF 53.536.005.01.010 A)
\$18,416
Floating crane concept used by Navy, Army, and Marine Corps, Fort Story, Virginia, joint tests. 1 x 3 5 7
- 10) Construction Guide Outlining Procedures Necessary to Build and Preserve Snow Roads by Means of Layered Compaction. TR 819. (YF 52.555.001.01.001)
\$474,037
Snow roads used in antarctic, arctic, Alaska, and by the Canadian government. 1 x 3 5 7
- 11) Investigating Expedient Deep-water Propellant Anchor Mooring Systems. TN 1413; TR 832; TDS 75-16. (YF 53.535.004.01.006)
\$60,793
Used by Navy at Diego Garcia (18 anchors) and in rescue work off Bermuda. Private sector use by oil industry for off shore platforms. 1 x 3 5 7
- 12) A Study of Electrical Safety In Naval Hospitals. TN 1275*. (YF 53.534.006.01.023)
\$66,006
Developed general purchasing specifications for Navy hospitals. Some use by National Fire Protection Association. 1 x 3 5 7
- 13) Comparing the Effectiveness of Thin Coatings to Control Corrosion. (YF 51.543.006.01.003)
\$28,823
1 x 3 5 7

WORK UNIT DESCRIPTION

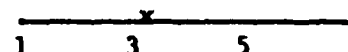
POTENTIAL FOR TRANSITION ONLY (5 total)

The "x" on the scale that is marked from one to seven, which accompanies each work unit description, is used to display the technology transfer effort associated with that work unit. The one on the left of the scale indicates low technology transfer effort while the seven on the right indicates high technology transfer effort.

- 1) Critical Appraisal of the Technical Literature Dealing with Thin-wall Reinforced Concrete Pontons, Corrosion of Steel Reinforcement in Concrete Exposed to Marine Conditions, and Cracking of Reinforced Concrete Exposed to Weathering. TN 1447; TDS 77-03. (YF 53.534.001.01.023)
\$19,911



- 2) Development of Prefabricated Panels for Rapid Fortification by Mobile Marine Forces. TR 770*; TR 1226. (YF 53.536.001.01.001)
\$181,848
Used by mobile marine forces.



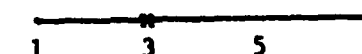
- 3) To Analyze, Develop, Test and Evaluate New Concepts for Earth Moving, Excavation and Land Clearing Related to Marine Corps Combat Operations. (YF 53.536.10m.01.004)
\$207,948



- 4) To Increase the Efficiency and Speed with which Naval Construction Force Equipment is Operated While Decreasing Skill, Coordination, and Attention Required by Operator. (YF 53.536.006.01.008)
\$70,656



- 5) Develop a Construction Assistance Vehicle for Use by Sea Bees in Sea Floor Military Construction Operations. (YF 38.535.003.01.004)
\$273,507



WORK UNIT DESCRIPTION

WORK UNITS THAT DID NOT TRANSITION (12 total)

The "x" on the scale that is marked from one to seven, which accompanies each work unit description, is used to display the technology transfer effort associated with that work unit. The one on the left of the scale indicates low technology transfer effort while the seven on the right indicates high technology transfer effort.

- 1) Experimental Hose Line for Adv Base Fuel Transport Over Deep Snow.

TR 814; TN 1027. (YF 53.536.003.01.012)

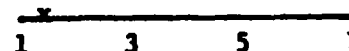
\$26,572



- 2) Are Aluminum Frame Motors More Suitable for Use in Salt Fog Environments Instead of Cast Iron Frame Motors.

TN 1464. (YF 53.534.006.01.042)

\$18,998



- 3) Investigation of the Hinging Mechanism in Under-Reinforced Concrete Beams Subjected to Static or Dynamic Loads.

TR 489; TN 901*. (YF 38.534.001.01.010)

\$294,236



- 4) Develop the Hardware and Procedures Needed to Safely and Quickly Guide a Container Lowered by Crane onto the Standard Military Container Chassis or Flatbed Truck. TN 1313. (YF 53.536.005.01.016)

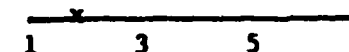
\$60,229



- 5) Air Pollution Episode Decision Processes for the U.S.N. (based on the military form of "Estimate of the Situation".

TN 1457*. (YF 57.572.002.01.014)

\$32,244



- 6) Tests Evaluating the Driving Capabilities of the Rapid-Impacting Hydroacoustic Pile Driver. TN 1362. (YF 53.536.006.01.011)
\$90,780
1 x 3 5 7
- 7) Develop Techniques and Equipment to Reduce the Exhaust Gas Pollutants from Navy Jet Engine Test Cells.
(FY 53.554.001.01.008) Progress Report 63-73-12 (NCEL)
\$67,130
1 x 3 5 7
- 8) Determining Significant Properties of Near-shore and Inshore Underwater Sites for Submarine Cable Installations. TN 1323.
(YF 53.535.001.01.006A)
\$54,505
Currently being used by the Navy to survey nearshore cable sites.
1 x 3 5 7
- 9) Develop a RDT&E Plan on the Dynamics of Cable Systems Suspended in the Ocean. (YF 53.535.004.01.008)
\$12,919
Used by Navy for cable system to moorings.
1 x 3 5 7
- 10) Study of the Dynamic Behavior and Resistance of Prestressed Beams. CR 72.016; TR 707; TR 721. (YF38.534.001.01.009)
\$153,961
This project has transitioned to 6.3 research.
1 x 3 5 7
- 11) Modification of a Pneumatic Track Drill for Underwater Use by Divers. TN 1339. (YF 53.535.003.01.014)
\$9,971
Used in equipment pool at CEL to support research.
1 x 3 5 7
- 12) Plan An Energy Program for Naval Shore Facilities and Remote Bases. (YF 53.534.006.01.031)
\$85,547
Concepts were used as basis for energy conservation program at Port Hueneme facility.
1 x 3 5 7

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